DOCUMENT RESUME

ED 021 549 JC 680 299

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GAMING VIA COMPUTER SIMULATION TECHNIQUES FOR JUNIOR COLLEGE ECONOMICS EDUCATION. FINAL REPORT.

Riverside City Coll., Calif.
Report No- NDEA-212-3B-B-8060- J(0)
Pub Date Jun 68
Note- 73p.
EDRS Price MF- $0.50 HC- $3.00
Descriptors- *COLLEGE CURRICULUM, *COMPUTER ASSISTED INSTRUCTION, *ECONOMICS, EXPERIMENTAL TEACHING, INSTRUCTIONAL IMPROVEMENT, *JUNIOR COLLEGES

A study designed to answer the need for more attractive and effective economics education involved the teaching of one junior college economics class by the conventional (lecture) method and an experimental class by computer simulation techniques. Econometric models approximating the "real world" were computer programed to enable the experimental group to play roles of monetary managers, economic advisers, or businessmen. The effectiveness of this instructional technique versus conventional instruction was tested by using a 2-tailed t-test on student performance. Also student interest was assessed via questionnaire. Results showed that gaming seemed to have elicited comparatively greater impact on student attitudes than did the conventional instruction. The cognitive objectives of the course were achieved with equal efficiency in both groups. The report includes course models, sample outputs, worksheets, and a bibliography. (DG)

Final Report
NDEA Title III-B
Project Number 212-B-8060 J(O)

GAMING VIA COMPUTER SIMULATION TECHNIQUES FOR JUNIOR COLLEGE ECONOMICS EDUCATION

June 1968

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GAMING VIA COMPUTER
SIMULATION TECHNIQUES FOR JUNIOR
COLLEGE ECONOMICS EDUCATION

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The instructional materials, techniques, and evaluation of effectiveness reported herein were performed with the aid of consultant services provided by the Bureau of National Defense Education Act Administration of the California State Department of Education. The resulting documents are the product of the author's efforts, the consultants who rendered expert services, and the sustained support of Riverside City College. The points of view or opinions stated are the free expression of the professional judgment of the author and do not necessarily represent positions or policy of the Bureau of National Defense Education Act Administration, the consultants to the study, or Riverside City College.

Foreward

This project is part of the continuing effort in junior colleges to improve the quality and impact of instruction at the collegiate level. The project as reported here is restricted to gaming instructional techniques as applied to economics education. The inquiry is therefore delimited in scope and treats specific games utilizing computer assisted media. While the methods, materials, and procedures reported here may stimulate developments in other subject-matter areas, the findings will be of primary interest to those in economics education, and only secondarily to other subject specialists.

While major responsibility for this project was carried by Mr. Fred A. Thompson of Riverside City College, the project would not have been possible without the cooperation of the college, the advice and counsel of consultants, and the interest and cooperation of others involved in economics education.

The author wishes to express appreciation for Riverside City College's contribution in accommodating the special requirements of this project's development. The administration and the data processing department of the college co-operatively removed impediments which would otherwise have sounded an early death knell to the project in its comprehensive final form.

The consultants to the project: Dr. Thomas B. Merson, Dean of Instruction at Bakersfield College (educational research), Dr. Micheal B. Intriligator, University of California at Los Angeles (econometrician), and Mr. Woodford Martin and Mr. Ernie Tolin (computer programmers); all merit special recognition.

To the economics instructors who agreed to attempt experimental replication at their colleges, Mr. Philip Starr of Chaffey College and Mr. Charles Bakewell of Mt. San Jacinto College, must be accorded the gratitude of those interested in the practical application of this technique in other environments.

Finally to Mr. Wylie A. Walthall of Laney College and Dr. James S. Earley of the Department of Economics at the University of California at Riverside who reviewed the initial draft of this report, my special appreciation.

Fred A. Thompson
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June, 1968

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Natura non facit saltum

Alfred Marshall

Background of the Project

The problems of all sciences can be formulated as the making of intelligent decisions with respect to actual or hypothetical courses of action. Nature does not gratuitously provide controlled experiments in economics whereby truths are bared. The crux of economic analysis--of the principles and relationships among economic variables--must reside with theoretical relationships expressed in model form. A model is a simplified scaled-down version of a situation or phenomenon which is the ultimate concern of economic analysis. Models render complex problems amenable to systematic study. There is always a corresponding cost in terms of irrelevance and artificiality.

The paradigms of economic theory take many forms. Descriptive models, such as a flow of economic activity, are designed to do no more than present a comprehensible overview of how economic activity occurs. Predictive models, such as econometric models of the entire U. S. economy, extrapolate recent trends to provide forecasts of economic conditions.[1] A third type of construct, the analytic model, is the most commonly used model genre in economic education. Familiar examples include the Keynesian models of macroeconomics and the market models of microeconomics.[2]

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[1] For example, see The Brookings Quarterly Econometric Model of the United States, ed. by James Duesenberry, Gary Fromm, Lawrence Klein, and Edwin Kuh (Chicago, 1965), pp. 681-722.

[2] Refer to Paul A. Samuelson, Economics, 7th ed., (New York, 1967), Chapters 13 and 24 for conventional examples of such models.

Any of these models may be presented in symbolic form, in quantitative mathematical form, or in an equivalent graphical form.

Teaching economists must be concerned with analytical models at two levels. First, does the model efficiently convey to students the information necessary to achieve the objectives of the course, i.e., is the model an effective learning device? Secondly, does the model intrinsically provide student motivation through analysis that is meaningful and relevant to real world events? The teaching economist must always consider student interest and the cognitive objectives of the course simultaneously since they often exist in tandem.

The effectiveness of the anlytical models as conventionally used in the elementary economics principles course is seriously questioned. The "tools of analysis" of economics more often than not become devices of obfuscation in the classroom. While some economists may take cabalistic delight in the obscurity of the esoteric technical apparatus of modern economics, this is not the aim of the educator. The educator is interested in teaching in such a way as to facilitate learning given the characteristics of his student clientele. To the educator, the model is not the end knowledge to be attained by recalcitrant students, but rather the vehicle through which knowledge and understanding of economic phenomenon may be effected. Analytical models which serve as effective teaching devices are means to the end goals or ultimate objectives which we sometimes designate as "economic literacy." It follows that economics educators might render a more valuable service to students if they were to pay more considered attention to their models <u>before</u> they entered a classroom. What are the specific objectives of this unit of study?

What models are appropriate in achieving these objectives? Which models will be most effective with these students? What method of presentation should be used in order to stimulate student interest?

The laconic catechism of traditional economics instruction too often tends towards a minutiae of trivia which has very little immediate or residual impact upon students of the elementary course.[3] Instead of the principles of macroeconomic fiscal policy, students are instructed in the nuances of the slope of consumption functions and shifting equilibrium levels of income. Instead of an overview of the modern firm and the market structure environment within in which it must operate, students are asked to reproduce patterns of cost and revenue curves of proper Marshallian contour and labeled according to the family, genus, and species of a taxonomy devised by venerable economists. It is not surprising that students either avoid such a course as the plague of lower division curricula, or mitigate the scourge with a rote memorization cookbook approach to the subject. Both such approaches (avoidance or cookbooking) obviate the ultimate objectives of economic education.

What, then, would an ideal teaching model be like? For pedagogical purposes economic models should have attributes of facile comprehensibility, relevance to significant real world phenomenon, and obvious transfer transitions from model implications to policy alternatives. In addition, the model should elicit from students a self-generating awareness and

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[3] George L. Bach and Phillip Saunders, "The Lasting Effects of Economics Courses at Different Types of Institutions," American Economic Review, LVI (June, 1966), p. 510.

abiding interest in economic problems and issues. The latter attribute of an ideal teaching model, sometimes referred to as "student motivation," is a subtle one. It is nevertheless an attribute without which neither the immediate cognitive objectives of an economics course may be fully realized, nor the long-term impact of economic education improved and sustained. Student interest and course effectiveness are mutually reinforcing in their effects. For the educator to ignore either would be a gross dereliction of responsibility.

This report is predicated upon improving the instructional effectiveness of various economic models via a relatively new and unproven instructional technique. The technique builds both from traditional economic theory and from new instructional media. There is little radically new about the methods and techniques bared here. A brief review of related techniques will follow this explicit statement of project objectives.

General Objectives of the Project

A recent study of economics education in California junior colleges revealed that less than 5% of junior college students receive any exposure to formalized instruction in economics.[4] The economic literacy of junior college students receiving no exposure to economics instruction is not significantly different than that of a large sample of high school seniors who have likewise never taken an economics course. As consumers in a private enterprise economy, and as citizens in a democratic political

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[4] Fred Thompson, Wylie Walthall, and Thomas Merson, Economics Education in California Junior Colleges, U.S.O.E., (June, 1967).

system, these students will face a multitude of decisions throughout their lives where rational and objective analysis of issues and problems will affect both the individual and the collective welfare. Economics offers the analytical tools through which individuals may reason effectively about economic problems. The alternative to more effective economics education is a future where such decisions are based upon ignorance, caprice, and prejudice. The need is clear. As a greater proportion of lower division students look to the junior colleges for their educational requirements, these institutions must provide the opportunities whereby greater numbers of students will be effectively taught economics. The junior colleges have thus far been unable to meet this challenge.

This project is an attempt to answer the need for more attractive and effective economics education through a unique approach to instruction in elementary economics. Econometric models approximating the "real world" will be computer programmed to enable individual students to play roles of monetary managers, economic advisers, or businessmen. It is asserted that this method of computer simulation will achieve educational objectives efficiently, while additionally eliciting student involvement and interest in economic affairs so necessary for sustained achievement and lasting educational impact. The method proposed is to be evaluated, and if proven effective, disseminated widely among instructors in economics. The hardware (IBM 1620 system) is accessible at most junior colleges. The cost in dollars and instructor time is low. The software is being constructed and will be inexpensive to duplicate.

The key assumption of this project is that a greater proportion of junior college students will be attracted to, and taught effectively in,

existing economics courses if the proposed teaching technique is utilized in instruction. The traditional economics course utilizes a textbook-lecture-workbook method of instruction. Students are bored by the abstract theory which seemingly has little relationship to the real world. Students chaff under the drill of trivial workbook problems. Students become passive notetakers in class, memorizing shibboleths for examination purposes, with little if any residual knowledge, changed attitudes, or skills remaining with the student after the final examination. Students are generally bored to intellectual death. The fault is not in the stars, nor in the students. The crux of the problem in economics education is artless instruction largely unchanged in technique for 200 years. If economic concepts can be taught in grades K-12, there is certainly no reason why they cannot be effectively taught in the junior colleges.

In general, the hypotheses to be tested are: there will be no significant differences in achievement between students taught in the conventional way, and students taught under computer simulation techniques in an elementary economics course.

The null hypothesis will be tested using a two-tailed t-test on student performance data. The level of significance will be set at 0.05, i.e., the null hypothesis will be rejected if the test of significance reveals a value less than 0.05.

Additionally, student opinion questionaires will be constructed to assess interest generated by the games utilized.

The general procedure to be followed will include: 1. constructing or adapting economic models to specific educational objectives,

2. programming the models in Fortan II for computer utilization,

3. utilizing the models in a classroom situation, and 4. evaluating the effectiveness of this instructional technique verses conventional instruction.

That simulations can be an excellent means of stimulating interest and understanding on the part of the participant, and can be particularly effective in the orientation of students who are unfamiliar with relationships assumed by economists, and present experiences from which insights arise, and effectively reorient student attitudes--these are my biases. In order that biases do not evolve into prejudices, careful objective analysis of the generated results will be necessary. For this reason, the specific research designs are specified and possible sources of invalidity explored.

The instructional materials and experimental findings generated by this project will be disseminated to interested individuals in economics education, either through the ERIC Clearinghouse on Junior Colleges, or by direct correspondence with Riverside Ctiy College.

Related Instructional Techniques

In designing learning situations educators have long been interested in the relationships between students, teachers, and subject matter. The teacher-dominated (lecture) method in economics instruction has predominated since long before the days of Adam Smith. Today, there are several types of pupil-centric patterns of instruction which allow active student involvement in a learning process. Active student response encourages the development of problem-solving abilities, attitudes of inquiry, and student interest. The transmission of lower level cognitions (e.g., knowledge of facts and definitions) is therefore often relegated to other instructional

media such as the printed page. The following brief descriptions are instructional techniques related to student-centered instruction.

The case study approach, which is commonly used as a method of instruction in courses in law and business administration, is a way of presenting comprehensive problems to students which they may then analyse by meaningful use of antecedent analytical constructs. Although the problem presented are temporal and specific, it is generally assumed that this method of instruction builds a cumulative understanding which may be transferred to other similar phenomenon.

Role-playing as a teaching method involves overt student assumption of behavior patterns of others in order to experientially learn functional relationships in a social context. The experience of other environmental situations, (e.g., labor-management negotiations, markets structured by specified economic forces, etc.) involving student interaction brings about emotional and cognitive learning approximating the reality replicated.[5]

Gaming is an instructional technique long utilized as a means of training students to apply appropriate strategies to achieve a defined goal function. Historically, gaming has been common in military instruction and, more recently, in business administration education. Educational games involve not only logic and theoretical analysis, but also subjective or judgmental evaluations dealing with imperfect information. Expectations regarding probable events thus enter into the decision-making process. The

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[5] See Myron L. Joseph, "Role Playing in Teaching Economics," American Economic Review, LV (May, 1965), pp.556-565.

over-all object of a game is to devise some rational policy (strategy) which will bring about a probable optimal array of outcomes given the goal functions of the participants (e.g., material gain).

Games in economics consist of sets of rules, abstractly comparable to the actual conditions of economic life. Around these rules, strategies are exercised by the player by manipulating certain decision variables in order to realize valued outcomes or consequences. Conflict, either among competing participants or among competing goals, serves as the basic operational constraint which must be compromised.

Simulations in economics refers to the technique of building models that reproduce part of all of the output of a behavioral system. Generally the models constructed have a time dimension, e.g., the results of a preceding period may be incorporated into a following period. Various objectives may be pursued with a simulation model such as forecasting, estimating values of unknowns, or generating hypothetical time paths when certain variables are controlled. Econometrics has contributed to the development of models integrating empirical research into theoretical constructs. With the advent of the computer, models of great complexity have become feasible.

The Basic Gaming-Simulation Process

The method of instruction pursued in this report incorporates all of the preceding instructional techniques in a dynamic or reiterative way. The student assumes a defined role, makes decisions, and bears the consequences of his decisions in a simulated environment approximating some subset of the economic relationships found in the real world. Students

are thus actively involved intellectually and emotionally in a learning process where a great deal of conceptual material is incorporated into a composite whole.

The advantages of computer aided instruction are numerous. The student is not forced to directly manipulate the complex mathematical relationships found in a sophisticated economic model. The computer manipulates the model, given student inputs. Students are thus liberated from the minutae of detail and tedium of routine calculations, and are free to examine many possible states of the world without computational constraints. In addition, many individual student responses can be processed before interest extinction takes place. Nearly immediate reinforcement is desirable in gaming situations. No other instructional medium allows the comparative speed, convenience, and degree of possible sophistication.

Related Research and Publications

The related research in the area of gaming utilizing computer simulations is not extensive, particularly with reference to economic education. More importantly, there is little evidence of systematic evaluation of the relative educational impact of such instructional techniques vis-a-vis conventional instruction.

Myron L. Joseph writing in the May, 1965 American Economic Review on "Role Playing in Teaching Economics," prefaced his presentation with:

> If our graduates do not understand and remember economic analysis or accept it as relevant to policy issues, we have failed. Whatever the cause, we are not having a strong enough impact on our students. Without ruling out the possibility that the subject matter of our courses may require critical re-examination, I suggest that we should focus more explicitly on the learning process.[6]

The author then reports on a teaching technique (role playing) which he feels substantially increases the educational impact on students through active student involvement in the learning process.

In another study entitled Mathematical Models in Teaching Economics, the authors build upon the work of Daniel B. Suits to construct a computerized model capable of simulating the U. S. economy for instructional purposes.[7] The decision variables and lagged data inputs required for each simulation are quite numerous (44 entries are required for each decision). Because of this, the model becomes cumbersome as a teaching device for students in elementary economics. The model used is also deficient with respect to theoretical simplicity (for student comprehension) and adherence to national income accounting conventions commonly presented in the elementary economics course.

Dr. Bernard F. Haley in his Experiments in the Teaching of Basic Economics devotes several pages to "Games and Simulation."[8] In most cases, however, the games described are in the developmental stage and have

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6 Ibid., p. 557

7 Vergil Miller and Barton Smith, Mathematical Models in Teaching Economics, U.S.O.E., (Cheney, Washington, 1966).

8 Bernard F. Haley, Experiments in the Teaching of Basic Economics, (New York, 1966), pp. 18-22.

yet to be adequately evaluated in terms of scientific experimentation of instructional effectiveness.

Dr. Richard E. Attiyeh of the University of California at San Diego has synthetically devised a comprehensive macroeconomic model explicitly designed for teaching purposes.[9] In manipulating the model economy, students possess two policy variables, government expenditures and a marginal tax rate, through which they may influence aggregate spending, employment, and the price level. Dr. At iyeh is also constructing a model incorporating monetary components for classroom use.

The following macroeconomic model is a direct result of Dr. Attiyeh's seminal work. The emphasis in application differs from Dr. Attiyeh's approach, the computer program and data processing procedures are original, and the evaluation of instructional effectiveness is unique for an instructional technique of this genre.

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9 Richard E. Attiyeh, "A Macroeconomic Model for the Classroom," New Developments in the Teaching of Economics, ed. Keith Lumsden (Englewood Cliffs, New Jersey, 1967), pp. 65-73.

THE MACROECONOMIC GAME

Introductory Remarks

Macroeconomics is the study of the principles and relationships to be found in aggregative data measuring income, output, employment, and prices occurring in the entire economy. The emphasis in such a course generally centers around the national income accounts, the theoretical and empirical relationships between economic variables, and the appropriate monetary and fiscal policies consistent with out national economic goals of price stability, economic growth, and full employment.

A considerable amount of effort has been devoted in economics to the quantitative specification of the relationships among economic variables (econometric models) which render our economic system amenable to study and social control. Questions of appropriate economic policy pivot on the goals of economic policy, the decision variables or policy tools available to influence economic outcomes, and the direction and magnitude of effect resulting when policy actions are pursued.

Conventional instructional procedures are replete with algebraic formulas, theoretical graphical expositions, and a plethora of esoteric jargon (e.g., the consumption function, marginal propensity to consume, equilibrium level of NNP, etc.). The student often fails to acquire an adequate understanding of economic theory and how it applies to economic policy decisions and events observed in the real world.

An Alternative Approach

The first questions to be answered when structuring a learning environment are: What are the intended outcomes of this unit of study in terms of measurable student behavior? What will they know? How will students be different when they terminate this unit of study?

The following statements constitute a partial listing of specific objectives for a unit of study in economics treating macroeconomic theory and fiscal policy implications:

1. Students will identify the limiting ceiling on potential productive capacity as being basically due to limited resources.

2. Students will identify the "output gap" as the difference between our potential GNP at full employment and our actual GNP.

3. Students will identify the level of aggregate demand as being the most important factor in determining whether the actual GNP approaches the potential GNP.

4. Students will identify the multiplier process as that magnified change in GNP resulting from a) a change in government expenditures, b) a change in tax rates, or c) a change in investment spending.

5. Students will identify "functional finance" as the conscious use of government fiscal policy to achieve full employment with price stability, with little or no regard to balancing the federal budget.

6. Students will identify gross investment as the most destabilizing of the major components of GNP.

7. Students will recognize a key difficulty in economic stabilization as being the problem of predicting aggregate demand accurately enough to take appropriate countermeasures via fiscal policy.

8. Students will identify reasonable price stability as a situation where 1-2% increase in the price level prevails.

9. Students will identify the unavoidable minimum of employment in the U.S. as between 3 and 4% of the labor force unemployed.

10. Students will be able to identify and explain trade-off relationships between stable prices and the level of employment.

11. Students will identify and define real economic growth as the deflated annual growth in GNP.

12. Students shall identify rapid rates of inflation as having adverse effects on the level of real output.

Once a set of objectives are specified, the next question is, "How may instructional materials and procedures be organized to intensify learning by these students?" It is immediately apparent that simply reproducing an aggregate demand function is not one of the educational objectives to be attained, even though nearly every major texbook seems to present the Keynesian model as if it were, in and of itself, the prime objective. Actually, the model must be viewed as a learning device through which student cognitions and understandings are effected. But is learning facilitated by the conventional model? How many thousands of man-hours have been expended on either explaining the model to students or simply requiring that students memorize the model for examination purposes, with so little immediate or long-term educational impact?

Instead of the conventional approach, the following instructions were given to students in the experimental group:

> The following is a brief description of an economic model that we shall use over a period of weeks to illustrate the principles of fiscal policy in achieving the goals of our economy.
>
> This model has been created to play the role of the real world. The exact mathematical relationships of this model are not important. You have available to you the variables (e.g., GNP, employment, rpice level, etc.) generated by this model for 10 time periods. As a student, you are now thrown into the same position as a policy-oriented economist. You have considerable information on the past performance of this economy, but no precise knowledge of the structure in which these variables are determined. Included in the model are two policy variables, which you are to determine. It will be your task to look at this model economy and, with the benefit of this history of performance, choose the next period's values for the policy variables so as to maximize economic welfare. The results of each decision will be fed back to you and new decisions

made based upon the results you have created. This decision-making process will be repeated every other class period until five decisions have been rendered. At the end of this process, the instructor will evaluate each participant's economy according to performance criteria based upon competitive rankings on price level, deflated GNP, and average uemployment rate.

You will be able to influence the performance of this economy through changing Covernment Expenditure (G) or Net Taxes (T). On your decision sheet you will indicate the policy variable for the next period. T* is the marginal tax rate. T* for any previous period is on your history chart for periods 1-10. If no decision sheet is rendered on the date it is due, the previous period's policy variables will be used.

Along with these general instructions, students received a ten-year history of performance of this model economy. A total of three class periods were used to acquaint students with the game and to discuss qualitatively what appropriate strategies might apply. No attempt was made to specify exact mathematical relationships among the variables. From the history of performance of this model economy students estimated the "multiplier" (which changes as the marginal tax rate changes), the target GNP for the next period to achieve maximum economic growth consistent with full employment and price stability, and the appropriate fiscal policy which would provide the level of aggregate demand consistent with these goals. The basic strategy, then, was the balance off aggregate demand with potential output. A 3% growth rate (compounded), a 4% unemployment rate, and a price level increase of 1% were all goals which could be achieved simultaneously if appropriate policies were followed. A lower unemployment rate could be achieved (with a minimum level of 3.5%) only if the student was willing to accept a higher rate of inflation. In addition, forecasts of changing investment expenditure levels (provided by the instructor) forced players to compensate for declines or surges in private sectc expenditures by offsetting public sector policies in order to maintain overall economic stability.

Student decision sheets were constructed by superimposing ditto imprints on optical scanning answer sheets which could quickly and economically be converted into punch card inputs. Samples of these student decision forms, the mathematical relationships of the macroeconomic model, and the FORTRAN II computer source program listing for the game are included in APPENDIX A.

In place of optical scanning answer sheets (requiring IBM 1230 Optical Mark Scoring Reader plus IBM 534 Card Punch equipment or the equivalent), mark-sense cards and complementary hardware may be used. The source program was written for use with an IBM 1620 Model I computer with a 1443 Printer, a 1311 Drive, and a 1622 Card Read Punch. Small modifications in the program will render it compatable with any equipment in common use. The game was constructed with this goal in mind.

Evaluation

Since the educational objectives of this unit of study were specified in advance, test items could be constructed which would assess student achievement of those explicit objectives. Therefore, an experimental research design was constructed, subject to desirable controls on possible sources of invalidity and carried out so that statistical testing of the general null hypothesis could be effected. To those educators who recoil at the thought of using students as "guinea pigs" in educational research, it should be clear that, at least in economic education, there is little or no opportunity cost involved in experimentation. Available evidence seems to suggest that there is ample room for improvement in the elementary economics course.

Students were divided by classes into an experimental group(those who played the game), and a control group (those who received conventional instruction). Neither group was informed of the experiment in advance, although the game seemed to stimulate so much student discussion beyond the classroom that students in the control group asked why they were not doing what the other classes were doing. The reply to this query was merely that this class was doing something different. For all they knew, <u>they</u> were the experimental group. But to the extent that isolation of the two groups was imperfect, some experimental error may have been introduced into the evaluation. There was no evidence, however, of any wholesale student collusion which might render spurious the findings of the study.

One possible source of invalidity in the experiment was instructor bias to influence the outcomes of the study. Since there was only one instructor participating in the controlled evaluative procedure, control on this source of invalidity was effected by distributing to both groups the specific behavioral objectives for this unit of study. Students knew in advance what was expected of them in terms of educational attainment. The control group was not slighted, but was told to read relevant chapters in the textbook used and to work out problems in the workbook. Five lectures were devoted to the conventional treatment of macroeconomic theory paralleling the exposition found in the most popular textbooks in use (Samuelson, Bach, and McConnell), with illustration by way of prepared transparencies and an overhead projector.

Another possible source of invalidity in the experiment might be attributed to the novelty of the media used by the experimental group (the computer and resulting personalized printouts). Whether there is an

inherent "hardware effect" with computer use, and whether this is the "gimmick" which actually affects performance rather than the gaming attributes of the learning process, are good questions. In order to rule out this possibility, students in the control group were given an individualized computer printout of a five-year simulation of the American economy (using another model) in conjunction with a lecture topic on forecasting. The theoretical relationships of this particular model were not discussed, and control group students did not manipulate the model in any way. In short, any possible differences in the performance of the two groups must be attributed to gaming verses conventional instruction.

Student Characteristics

Students in this economics class were composed of college sophomores intending to transfer to a four-year college. The modal age of the students was 19. Over 60% were majoring in some aspect of business administration. The experimental group and the control group had the following ability and previous knowledge of economics characteristics when entering the course. (See next page for Table.)

TABLE 1

Pre-Test Data, Both Groups

Control Group	SCAT*	TEU**
N = 38		
Mean	303.94	30.62
S.D.	8.74	5.27
Experimental Group		
N = 105		
Mean	303.36	29.92
S.D.	11.03	6.45
Differences of Means		
Difference	0.58	0.70
S.E.	1.86	1.11
Z	0.31	0.63

* School and College Ability Tests (verbal and quantitative), Educational Testing Service.
** Test of Economic Understanding, Science Research Associates, Inc.

Since the critical value of Z for the two-tailed test at the 0.05 level of significance is + or - 1.96, the hypothesis that these two groups were significantly different either in terms of ability or previous knowledge of economics cannot be accepted (or, the null hypothesis in this case cannot be rejected). The two groups are nearly identical with respect to the above-mentioned characteristics.

The experimental interference occurred after the midterm period of the course. Two test instruments, one consisting of 35 multiple-choice questions derived from the specific objectives, and one essay question,

were used to measure student achievement in the two groups. The essay questions were read and graded by an experienced economics instructor who was not aware of the evaluative procedure or which students were taught via gaming and which were taught via conventional instruction. These data are presented in TABLE 2.

TABLE 2

Experimental Data

Control Group	MIDTERM (before interference)	OBJECTIVE (35 points)	ESSAY (15 points)
N = 38			
Mean	59.11	21.32	10.24
S.D.	8.12	3.15	1.91
Experimental			
N = 105			
Mean	61.28	22.04	10.22
S.D.	12.31	4.64	2.53
Differences of Means			
Difference	-2.17	-0.72	0.02
S.E.	1.78	0.68	0.40
Z	-1.22	-1.06	0.04

Again, the data do not support rejection of the null hypothesis when either the objective measure or the third-person subjective measure of student performance is evaluated statistically.

There are two inferences which might be explored with respect to the experimental findings. One obvious inference would be that, at least with these students, the method of instruction was of little importance in influencing outcomes. A more subtle inference might be that there was an

inadvertent interference introduced into the experimental procedure when students were given the specific objectives to be achieved in this unit of study. In fact, the behavioral objectives may promote a much stronger interference than any comparative teaching methodology. This element of the research design, while sound educationally, may in fact mask experimental findings. In the interest of measuring this effect, it was hypothesized that the educational impact of behavioral objectives might be relatively more important in the short-run, while gaming (involving active emotional and intellectual involvement in a learning process) would tend to have a long-term impact. Accordingly, 20 of the multiple-choice questions previously used to evaluate student performance were repeated within the 150-question final examination given to both groups. These questions were used as a measure of the comparative residual impact of this unit of study. The time interval between assessments was 7-8 weeks, depending upon final exam scheduling for the classes involved.

(See next page for Table 3.)

TABLE 3

Residual Impact		
Control Group	**Repeat Questions (20 points)**	**Entire Final (150 points)**
N = 38		
Mean	15.80	117.95
S.D.	2.68	13.59
Experimental Group		
N = 105		
Mean	16.41	116.71
S.D.	3.26	17.24
Differences of Means		
Difference	-0.61	1.24
S.E.	0.52	2.77
Z.	-0.56	0.45

Again, rejecting the null hypothesis is not warranted by the data presented here. It must be noted, however, that previous examinations were used in class as a learning device (i.e., the exam questions were reviewed in class along with item analysis data after each examination), and previous examinations were available on library reserve to aid students studying for the final examination. Thus, considerable historical contamination was present in to influence these results.

Finally, the dispersion of final grades among the two groups (control and experimental) differed markedly. The control group was evidenced by a great number of "C" letter grades with few high or low marks. The experimental group received all of the "A" grades and a greater proportion of "F's." Since the experimental group had experienced a different type of educational procedure (e.g., monetary policy presented conceptually

as a "game," and practical difficulties in implementing stabilization policy treated as a political "game"), one last statistical evaluation was conducted.

The dependent variable Y (total points earned during the course) was taken to be a function of student ability (SCAT score), previous knowledge of economics (Test of Economic Understanding), a motivation proxy (previous G.P.A.), and a dummy variable (dichotomous variable: 1 = control, 0 = experimental). Thus, the multiple regression equation is:

$$Y = A_o + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4$$

where:

Y = dependent variable, total points.

A_o = y intercept.

B_1 = partial regression coefficient on independent variable X_1.

X_1 = SCAT.

B_2 = partial regression coefficient on independent variable X_2.

X_2 = Test of Economic Understanding.

B_3 = partial regression coefficient on independent variable X_3.

X_3 = previous G.P.A.

B_4 = partial regression coefficient on independent variable X_4.

X_4 = dichotomous 1, 0.

The data was prepared for computer input, and a standard linear regression program deleted independent variable X_4 in accordance with the T-Test and returned the following predictive equation with a standard deviation from the regression = 0.2339084:

$$Y = -0.48678922 + 0.61827146\ X_1 + 0.13707296\ X_2 + 0.2444038\ X_3$$

The equation indicates that the descending order of predictive ability of the three remaining variables was 1) SCAT, 2) previous G.P.A., and 3) previous knowledge of economics. Gaming was not a significant influencing factor in determining student performance over the entire course. The variance was adequately "explained" by the other three independent variables used in this analysis.

Another interesting aspect of gaming as an instructional device is its alleged impact on student attitudes and values. It is commonly believed that students entering the elementary economics course have an enduring prejudice in the area of public finance which holds government deficits and the federal public debt to be unmitigated evils leading ultimately to penurious ruin. The macroeconomic game is so constructed as to encourage the conscious creation of government deficits to achieve the economic goals of the model economy. A properly stimulative deficit leads to a much more desirable array of outcomes than does a rigidly balanced budget (G = T). On the other hand, overzealous use of government deficits in the game invite spiraling price level increases and dampened deflated economic growth rates.

The following attitudinal questionaire was constructed and administered to the control and experimental groups on a pre-and post-test basis. Students were informed that their responses would in no way influence their grade in the course. Students were asked to place their names on their survey instruments to discourage irresponsible replies. The time-span between assessments was four weeks.

(See next page for questionaire.)

EXHIBIT A

FISCAL POLICY GOALS

Please rank the following economic goals according to what you think their relative importance should be. For example, the most important economic goal would be ranked #1, the second most important #2, etc.

Rank	Goal
_____	Economic Growth
_____	Balanced Government Budget (if possible)
_____	Full Employment
_____	Price Stability

A: agree
0: no opinion
D: disagree

Please circle what you feel is the appropriate response.

1. A 0 D A large national debt promotes inflation and threatens national bankruptcy.
2. A 0 D Fiscal policy requires conscious creation of budget deficits or surpluses.
3. A 0 D The primary purpose of tax policy is to furnish revenue to the government.
4. A 0 D Sound finacing requires that the government balance its budget.
5. A 0 D The size of the total national debt has less impact on current economic activity than changes in debt.
6. A 0 D The primary objective of federal tax policy is to keep the economy stable and growing.

The latter portion of the questionaire was constructed to serve as an index of complicity, i.e., responding the way you believe the instructor wants you to respond. If a student ranked "Balanced Government Budget" (EXHIBIT A) as #4, the complicity in response was measured by assigning values:

Items 1, 3, 4	Items 2, 5, 6
A = -1	A = +1
0 = 0	0 = 0
D = +1	D = -1

Thus, complete consistency with the #4 ranking of "Balanced Government Budget" would yield a +6 on the item analysis above. Complete inconsistency would yield a summed value of -6. The complicity index mean for the two groups (control and experimental) was calculated by summing all individual complicity values and dividing by N.

TABLE 4

Attitudinal Change

Pre-Test Rankings

Experimental Group (N = 101)			Control Group (N = 36)	
Goal	Mean Rank	S.D.	Mean Rank	S.D.
Economic Growth ...	1.60	.27	1.59	.20
Balanced Budget ...	3.59	.23	3.68	.26
Full Employment ...	2.16	.25	2.29	.25
Price Atability ...	2.60	.29	2.56	.25
(% ranking balanced budget #4 = 69%)			(% ranking balanced budget #4 = 77%)	
Complicity Index = -1.2			Complicity Index = -.98	

Post-Test Rankings

Goal	Mean Rank	S.D.	Mean Rank	S.D.
Economic Growth ...	1.88	.90	1.58	.27
Balanced Budget ...	3.98	.10	3.97	.14
Full Employment ...	1.86	.26	2.25	.26
Price Stability ...	2.28	.21	2.30	.77
(% ranking balanced budget #4 = 92%)			(% ranking balanced budget #4 = 89%)	
Complicity Index = +3.2			Complicity Index = +2.1	

The first rather surprising item in the data is the low ranking accorded to "Balanced Government Budget" on the pre-test. Informal surveys revealed that this may have been in part due to a lecture (before the survey)

on the national income accounts in which interest payments for servicing the government debt were presented as a transfer payment. The post-test data reveal a substantial shift in attitudes by both groups with reference to a balanced budget. The complicity index reveals that even among those who ranked this item last on a pre-test basis, most did not hold concurrent attitudes consistent with that belief. The post-test complicity index reveals that the experimental (gaming) group of students not only ranked the item #4 for 92% of the students surveyed, but also had acquired a concurrent set of attitudes more nearly consistent with that ranking than had the control group. Rank correlation coefficients were not used to analyse the data presented in TABLE 4, and so the statistical significance of the findings cannot be rigorously stated.

Finally, a fairly standard 18 item Instructor Rating Scale was administered to both groups of students at the end of the course to assess student attitude towards economics after one semester of instruction. Each item on the scale could be rated from 0 (lowest possible rating) to 10 (highest possible rating), with nine gradations between. There was usually a marked serial correlation among the 18 items rated by each student (i.e., the ranking gradations tended to be homogeneous for each student respondent, clustering closely around some mean ranking).

The experimental group evidenced a mean ranking of 8.4, while the control group mean ranking rating was 7.7. Under "additional comments" on the rating scale instrument, fully 34% of the students in the experimental group made a favorable reference to the macroeconomic game, and an additional 30% rendered some other favorable comment on the course. In the control group, only 21% offered any comment on the course at all. Just one comment from the control group was hostile, with the vast majority offering benign or salubrious replies.

Evaluation Summary

The experimental findings of this report indicate that the cognitive objectives of a unit of macroeconomics may be achieved with equal efficiency by gaming techniques or conventional instruction. The results may not be generalized, however, to other student populations or to other games. Certain deficiencies in the research design, chiefly the sensitization of experimental subjects via behavioral objectives and the unknown reliability of test instruments utilized, may have affected outcomes.

Gaming seemed to have elicited comparatively greater impact on student attitudes toward government spending, and a favorable attitude towards the course as a whole than did conventional instruction.

To those who say that replication is impossible, full disclosure of the research design, statistical techniques, and the instructional materials utilized are presented in this report. Another instructor who participated in this gaming experiment (but not in the evaluation) comments:

> Students who reinforce their learning in economics with participation in the operation of their own economic model gain confidence in the relevance of economic variables as they exist in the economic problems of industries and countries. With first-hand experience in seeing how the interaction of economic magnitudes works out from period to period, they are in better shape to discuss and evaluate economic issues wherever they arise.
>
> One student whose attitude toward economics was summarized with the statement, "There must be a better way to learn this stuff!" agreed heartily that practise in the operation of his own model was part of the improvement in intelligibility he hoped for. Another student of introductory economics declared that previously he had been tongue-tied when someone who professed some acquaintance with the subject of economics spoke out in company matters, but that since he has now seen how the thing operates he feels able to hold up his own end even when discussing such matters with admitted economics majors.

> There has been an impressive general eagerness shown by students in participating. Some of them have even worked more than a single system to keep the model of some absent fellow member of the class going. They have welcomed the opportunity to try out alternative adjustments for comparative effects.
>
> With a computer to assist their understanding, students regard economics as a more reasonable body of theory and information, and are far more willing to commit themselves to respond to the point of view which economics provides them in their capacities as citizens and as individuals, both.[10]

How many economics students are led to actually enjoy the nuances of macroeconomic theory? There <u>are</u> alternatives.

A more sophisticated macroeconomic model derived from a yet unpublished paper by F. Trenery Dolbear, Jr., Richard Attiyeh, and William Brainard is presented in APPENDIX B. This model includes a monetary component (the money supply) as a student decision variable. It also incorporates a Cobb-Douglas production function. This model is more difficult to run from a processing or production standpoint since history data cards are required.

A Monetary Policy Game

In the future it will be possible to construct a realistic monetary policy game. When this occurs, both fiscal and monetary policy may be presented in a gaming context. Indeed, separate teams in the class representing the monetary authorities and the fiscal authorities may interact to influence economic outcomes in a single model economy. But a monetary model presents some "state of the art" difficulties. The basic monetary policy problem may be stated in the following way:

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10 Information in a letter to the author from Charles Bakewell, Economics Instructor, Mt. San Jacinto College, January 7, 1968.

> There is at any point in time some optimal policy mix (through manipulation of the policy instruments of the discount rate, reserve requirements, and open-market operations) which will tend to maximize the goal function of a specified economic system, subject to the operational constraints of that system. Since the effects of policy decisions are known only after a time lag (the "outside lag"), monetary target proxies (interest rates, free reserves, money stock, or monetary base) are selected as responsive interim indicators of policy effectiveness. The ultimate concern of monetary policy is the goal function which includes aggregate demand, employment, real income over time, price stability, and balance of payments considerations.[11]

There are several difficulties presently impeding model development. The nonstochastic model components are not known with certainty, particularly the values of the parameters of the monetary components of the economic system. The values of goal data feedback are observable only as lagged data meaning that policy effects in period t are observable in period t+2. The monetary target proxies are affected not only by monetary policy, but also by pro-cyclical and countercyclical effects generated by the economic system itself through aggregate demand, exogenously determined variables, and even random events. It is clear that a reduced form of the system is needed. It is not clear that anything other than a naive model is feasible. Development of such a model was reluctantly beyond the capabilities of the modest resources committed to this project.

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[11] See Thomas R. Saving, "Monetary-Policy Targets and Indicators," The Journal of Political Economy, LXXV (Supplement: August, 1967), 446-456.

THE MICROECONOMIC GAME

Introductory Remarks

Microeconomics (traditionally called price theory) is the disaggregation of prices, costs, resource allocation, and the distribution of income. Thus, microeconomics is concerned with the study of the behavior of individual firms, households, market prices, wages, and incomes within the context of allocating limited resources among alternative ends to maximize want satisfaction.

A large segment of the typical principles course in microeconomics deals with business enterprise, supply and demand, relationships between costs, prices, and output levels under various market structures, and the problems of maintaining workable competition in our predominantly market-directed economy.

In an era when students are protesting against the seeming irrelevance of much of the education imposed upon them--education justified chiefly by tradition, or by habit, or by the convenience of professors--the traditional two-dimensional treatment of pure competition or unregulated monopoly alienates students with an efficiency seldom evidenced in academia.

Any of the conventional market structures can be formulated into a gaming context in which students make decisions and bear the consequences

of those decisions in a simulated environment.[12] Using such games as innovative teaching devices, students are able, in an understandable and lively way, to see how economic theory may be applied in a variety of realistic and complex situations.

In the search for relevance in economic education, one might muse the words of John Kenneth Galbraith:

> A year or two ago, the United States Department of Commerce, invading an activity hitherto reserved, at least in Democratic administrations, to private enterprise, published a small pamphlet setting forth the blessings of capitalism. It illustrated these by describing the operations of a lemonade stand conducted by two children under the trees. This was in keeping with well-established practice in economic education which regularly holds that capitalism can best be understood by examining enterprises with little or no capital, guided by one person, without the complications of corporate structure and where there is no union. Economic life began with small firms, with small capital, each under the guiding hand of a single master. A systematic and internally consistent theory, that of the competitive firm in the market economy, is available for the explanation of such an economy. This lends itself well to pedagogy.
>
> But this view of the economy is not sanctioned by reality. Nor is it sanctioned--a nostalgic and romantic minority apart--by economists.[13]

In student parlance, "Where's the action?" Which are the most relevant market models for today's world? Cast one vote for the area in the competitive spectrum labeled "Monopolistic Competition" and "Oligopoly."

Once this emphasis is established, one selects the most effective way of presenting such material to liberal arts and business students. Is it

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[12] See Thomas H. Naylor and others, Computer Simulation Techniques (New York, 1966), pp. 192-222.

[13] John Kenneth Galbraith, The New Industrial State (Boston, 1967), p. 8.

to be "kinked" demand curve, an assigned reading, Galbraithian prose, or something else? Cast one vote for something else.

An Alternative Approach

Fortunately, there are several existing business games available for general applications in economics.[14] After suitable modification of the computer program to match equipment capabilities or in order to alter demand elasticities and cost functions, students form corporations in class and compete as rival business firms in a dynamic simulated environment. Decision variables include product price, production volume, marketing, research and development, investment in plant and equipment, and stockholder dividends. The computer completes the necessary calculations according to model specifications and returns reports to each firm including an operating statement, an income statement, a profit and loss statement, a cash flow statement, and a balance sheet. The data are interpreted (accounting students usually rank high in the corporate structure), and new decisions are rendered for the reiterative process which condenses several years of experience into a few class periods.

Such a learning environment, aside from its motivational attributes, provides the frame of reference within which many of the topics of microeconomics may be effectively presented. Economic concepts advantageously presented within this context include: price and non-price competition, market demand, demand creation, profit maximization, industry pricing interdependence, collusion and Antitrust, costs and revenues, and labor-

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[14] Two suggested sources are: THE EXECUTIVE GAME, IBM 1620 General Program Library, order number 11.0.036, or Richard C. Henshaw, Jr. and James R. Jackson, The Executive Game, Richard D. Irwin, Inc. (1966).

management relations. In addition, a wide variety of information emanating from the mass media becomes amenable to avid student interpretation and analysis.[15]

Evaluation

Since the three economics classes participating in the microeconomic game also participated in the controlled evaluation of a programmed textbook during the semester, the classes did not experience identical educational experiences prior to playing the game. The research design utilized was subjected to several internal and external sources of invalidity including possible interaction effects, historical contamination, and deficient controls on extraneous variables. For this reason, a rigorous statistical treatment of test data to measure the significance of the comparative impact of gaming verses conventional instruction will not be reported here.

What is offered here instead is a qualitative comparison of two essays written by students on an examination in response to an identical question. The two students were of comparable abilities (as measured by college entrance scores) but had received differing instructional treatments. Student X had worked through relevant material in a programmed textbook, and had concurrently read appropriate chapters in a popular textbook. Student Y had worked through the programmed text during a three-week period, and participated in the microeconomic game, with no other assigned instructional

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[15] An interesting example of this occurred in a news article entitled, "U. S. Steel Cuts Prices to Fight Import Boom, Dismaying Other Mills," Wall Street Journal, May 9, 1968, p. 1.

materials prior to testing.[16] Both of the following answers received "A" marks, but they were not atypical.

EXHIBIT B

Question

Between the market models of perfect competition on one hand, and unregulated monoply on the other, lies the "grey area" of the competitive interaction among the majority of today's corporations. Discuss and evaluate the implications of the following concepts both from the point-of-view of the producer and the consumer when imperfect competition prevails:

a) price competition
b) non-price competition
c) product differentiation
d) resource allocation

Student X Essay Reply

The "grey area" of competition includes monopolistic competition and oligopoly. In monopolistic competition there are a substantial number of firms competing in the market, with sellers offering products which are different in some way from the competition's. In oligopoly the market is dominated by a few large firms (for example the automobile industry) and competition is not very keen due to "live and let live" policies. In fact, collusion and administered prices are common. Price competition is especially dangerous in oligopoly because cutting prices will lower total revenue when all firms do it. This is because demand is inelastic and other firms will lower their prices too. From the consumer's viewpoint more price competition would be to his advantage, but it is unlikely if there is a kinked demand curve. Non-price competition takes place when firms advertise and promote their product. This kind of competition allows the producer to increase his sales without price cutting. Some advertising is informative, but most of it is just salestalk. The consumer could get some products cheaper if there were no advertising. Product differentiation occurs when the producer makes his product different by putting it in an attractive package, or promoting it by brand name, or by making people believe that it is new or better. The consumer benefits if the product really is improved, but often the product isn't really new or even very different from other close substitutes available. An example of product differentiation would be Bayer Aspirin.

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16 The programmed text was, Robert C. Bingham, Economic Concepts: A Programmed Approach (New York, 1966). The conventional textbook used was, George L. Bach, Economics: An Introduction to Analysis and Policy, 5th ed. (Englewood Cliffs, 1966), with assigned Chapters 27, 28, and 29, pp.426-477.

Resource allocation is supposed to be best when P = MC = MR as in pure competition. Waste occurs when monopolistic competitors spend billions of dollars on advertising when the labor and capital used could be producing other things. Whenever there is imperfect competition, the price charged is greater than average cost, and average cost is greater than the minimum long-run average cost according to economic theory.

Student Y Essay Reply

a) Our industry attempted to hold a uniform price policy, but the agreement broke down in the second quarter of operations, and price cuts followed. This situation (a price war) continued until most of the firms agreed that more was to be gained by an understood limitation on price changes. Thereafter price competition was generally limited to small price changes, with a fairly stable average price for the industry. Price competition was very difficult to maintain because the other firms would retaliate and everyone's profits would be lower in the long-run. The consumer might not be happy since he wasn't getting the lowest possible price, but our stockholders are more important to us. b) When it was apparent that we couldn't use price as a sales weapon, we relied more on marketing and R & D expenditures to keep our market share intact. Soon we were competing with the other firms on almost everything except price. We cut internal costs to boost our profits, but we found that if we cut our marketing and R & D we lost sales. Our costs were creating demand and increasing revenues. We kept increasing these outlays until we felt that the increase in cost exceeded the increased revenue. This is something like MC = MR in Bingham. In fact, we have even started to ignore our fixed costs when we make our decisions. c) From the start of the game we decided to produce a brand-name, quality product. We made our product different through advertising and through quality improvements made possible by R & D. If our product was exactly like the other firms' products, we wouldn't have any competitive edge. d) We devote our firm's resources to making profits. If the consumer wants low priced goods with no marketing costs, why doesn't he act that way? We are only concerned with what is successful in our business environment. If the consumer wants better widgets, he gets them. If he buys only the lowest priced item, he gets low prices. If he buys our nationally advertised brand, that's what he gets. Supply and demand is a two way street. The consumer gets what he wants at a price he is willing to pay. Finally, let me say that the price equals average cost stuff in Bingham is pretty hard to swallow. No businessman in his right mind would go for that!

The preceding essay examples, to my way of thinking, exhibit essentially the same content. The point-of-view of the two respondents differs slightly. Student X has obviously acquired more of the proper terminology

from his reading, while student Y probably has a superior intuitive grasp of the meaning and relevance of economic concepts. To say that one product is better than the other is a debatable assertion.

Examples of the decision forms utilized and samples of the printouts are exhibited in APPENDIX C. Game sources are cited in the BIBLIOGRAPHY.

Conclusion

The generation of student interest in economics is greatly aided by planned gaming-simulation learning environments. In the microeconomic game, corporations held meetings outside the classroom to analyse performance data, discuss appropriate strategies, and formulate corporate policy. The number of students consulting the instructor quadrupled while the game was utilized as an instructional tool.

Constructing and developing additional games appropriate for economics instruction deserves the concerted attention of the profession. Development costs of such games (e.g., an international trade game) exceed the resources of one professor in one educational institution, and may involve years of arduous work and evaluation by a team of specialists. The end products, however, could revitalize economics instruction so that the profession may artfully and effectively transmit to students the valued outcome termed "economic literacy."

A P P E N D I X A

Macroeconomic Model--Mark II

Contents:

1. Mathematical Computations
2. Instructor Cover Form
3. Student Decision Form
4. Sample History of Performance
5. FORTRAN II Source Program
6. Sample Student Printout

MACROECONOMIC MODEL -- MARK II RIVERSIDE CITY COLLEGE

The mathematical computations for the macroeconomic model are made with the following equations and parameters. Two exogenous variables are supplied by students. One exogenous variable is supplied by the instructor. Three variables from the previous period provide historical continuity.

Supplied by Students

Decision Variables:

G* = Government Expenditure, Current Dollars
T* = Marginal Tax Rate

t-1 Data: P*, X*

Supplied by the Instructor

I* = Random Variation in Investment, assumed to be a stochastic variable drawn from a probability distribution with a mean of zero.
L* = Labor Force, Previous Year

Variables Defined

Y = Gross National Product, Current Dollars
C = Consumption Expenditure, Current Dollars
I = Gross Investment Expenditure, Current Dollars
G* = Government Expenditure, Current Dollars
P = GNP Deflator, Current Year
X = GNP in Constant Dollars
L = Labor Force (Millions)
Q = Potential GNP, Current Year
U = Unemployment Rate
T = Net Taxes (Taxes - Transfers) Current Dollars
I* = Stochastic Investment (Random Variable)
T* = Marginal Tax Rate
P* = GNP Deflator, Previous Year
X* = GNP in Constant Dollars, Previous Year
L* = Labor Force, Previous Year

Formulas Calculated

1. $Y = \frac{G^* + I^* + 115.485}{.93\ (T^*) + .0495}$
2. $I = .16\ (Y) + I^*$
3. $C = Y - I - G^*$
4. $L = 1.018\ (L^*)$
5. $T = -94.5 + T^*\ (Y)$
6. $Q = 1.03\ (P^*)\ (X^*) + .3I^* + .7\ (L - L^*)$
7. $P = 1.01\ (P^*) + \left[\frac{Y}{Q} - 1\right]$; if $\frac{P}{P^*} > 1.06$ add $\left(\frac{4P}{P^*} - 4.24\right)^2$

iff positive value

Special Condition: P inflexible downward
Special Condition: U cannot fall below .035

8. $X = \frac{Y}{P}$
9. $U = .040 + \frac{Q - Y}{2Q}$

Macroeconomic Model--Mark II

INSTRUCTOR COVER FORM

Instructor: _____
(last name)

Class Code: | | | | |

I* Value: | | | | . |
+or-

Current Year: | | |

Previous L: | | | | . |

Remarks:

MACROECONOMIC MODEL DECISION SHEET

Name _____ Code _____ School _____

Enter 5 digit Identification Student Number . . . . .

	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9

CURRENT VARIABLES

I. G = Government Expenditure (Current dollars)

	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
.	0	1	2	3	4	5	6	7	8	9

II. T_x = Marginal Tax Rate

.	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9

VALUES FROM LAST COMPUTER RUN

I. P_x = Previous year's price level

	0	1	2	3	4	5	6	7	8	9
.	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9

II. X_x = Previous years GNP deflated. (Enter 5 digit figure)

	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
.	0	1	2	3	4	5	6	7	8	9

MACROECONOMIC MODEL-RIVERSIDE CITY COLLEGE

Student Number Name Class Code *INDICATES INPUT VALUES

Year	Y	C	I	G*	P	X	L	Q
1	846.6	509.1	137.4	200.0	1.010	838.2	81.4	851.3
2	876.6	531.2	140.2	205.1	1.024	855.8	82.8	873.0
3	897.4	536.9	139.5	220.9	1.030	871.1	84.2	901.8
4	983.6	591.1	162.3	230.1	1.101	892.8	85.7	926.7
5	963.8	571.7	156.7	235.4	1.112	866.7	87.2	1014.2
6	1033.9	615.4	168.4	250.0	1.162	889.3	88.7	994.6
7	1025.4	611.4	164.0	250.0	1.173	873.7	90.2	1065.4
8	1067.4	636.6	169.2	261.5	1.195	893.0	91.8	1056.2
9	1129.6	672.2	181.7	275.6	1.233	915.9	93.4	1100.6
10	1186.7	711.4	189.8	285.4	1.264	938.4	95.0	1164.3

Y = Gross National Product, Current
C = Consumption Expenditure, Curren
I = Gross Investment Expenditure, C
G*= Government Expenditure, Current
P = GNP Deflator, Current Year
X = GNP in Constant Dollars
L = Labor Force (Millions)
Q = Potential Gross National Produc
U = Unemployment Rate
T = Net Taxes (Taxes-Transfers) Cur
I*= Stochastic Investment (random v
T*= Marginal Tax Rate
P*= GNP Deflator, Previous Year
X*= GNP in Constant Dollars, Previo
L*= Labor Force, Previous Year

T VALUES

X	L	Q	U	T	I*	T*	P*	X*	L*
838.2	81.4	851.3	.042	201.8	2.0	.350	1.000	825.0	80.0
855.8	82.8	873.0	.037	203.5	0.0	.340	1.010	838.2	81.4
871.1	84.2	901.8	.042	215.1	-4.0	.345	1.020	858.6	82.6
892.8	85.7	926.7	.035	230.1	5.0	.330	1.030	871.1	84.2
866.7	87.2	1014.2	.064	234.1	2.5	.341	1.101	892.8	85.7
889.3	88.7	994.6	.035	246.6	3.0	.330	1.112	866.7	87.2
873.7	90.2	1065.4	.058	243.9	0.0	.330	1.162	889.3	88.7
893.0	91.8	1056.2	.035	252.4	-1.5	.325	1.173	873.7	90.2
915.9	93.4	1100.6	.035	266.9	1.0	.320	1.195	893.0	91.8
938.4	95.0	1164.3	.035	273.3	0.0	.310	1.233	915.9	93.4

oss National Product, Current Dollars
nsumption Expenditure, Current Dollars
oss Investment Expenditure, Current Dollars
vernment Expenditure, Current Dollars
P Deflator, Current Year
P in Constant Dollars
bor Force (Millions)
tential Gross National Product, Current Year
employment Rate
t Taxes (Taxes-Transfers) Current Dollars
ochastic Investment (random variable)
rginal Tax Rate
P Deflator, Previous Year
P in Constant Dollars, Previous Year
bor Force, Previous Year

1620 FORTRAN II SOURCE PROGRAM

```
      YR=0.
      CODE=0.
      STNO=0.
      IF(SENSE SWITCH 9) 1,1
    1 TYPE50
    3 READ55, CSTNO,A,B,D,E,H,YR,G,TS,VS,PS,XS,FS,CODE,CA,CB,CD
    4 IF(STNO-CSTNO)5,8,5
    5 PRINT80,CA,CB,CD
      PRINT60,CSTNO,A,B,D,E,H,CODE
      PRINT65
    8 W=G+VS+115.485
      R=(.93*TS)+.0495
      Y=W/R
      V=(.16*Y)+VS
      C=Y-V-G
      F=1.018*FS
      T=-94.5+(TS*Y)
      Q=(1.03*PS)*XS+(VS*.3)+(F-FS)*.7
      Z=(Y/Q)-1.
      IF(Z)10,10,13
   10 P=1.01*PS
      GO TO 15
   13 P=1.01*PS+Z
   15 IF((P/PS)-1.06)200,200,100
  100 P=P+((4.*P)/PS-4.24)**2
  200 X=Y/P
      U=.040+((Q-Y)/(Q*2.))
      IF(U-.035)16,17,17
   16 U=.035
   17 IF(STNO-CSTNO)18,19,18
   18 STNO=CSTNO
      PRINT72,YR,Y,C,V,G,P,X,F,Q,U,T,VS,TS,PS,XS,FS
      GO TO 20
   19 PRINT70,YR,Y,C,V,G,P,X,F,Q,U,T,VS,TS,PS,XS,FS
   20 IF(SENSE SWITCH 9)25,3
   25 TYPE75
   65 FORMAT(1HO,2X,4HYEAR,4X,1HY,6X,1HC,7X,1HI,6X,2HG*,6X,1HP,7X,1HX,6X
     1,1HL,7X,1HQ,6X,1HU,6X,1HT,5X,2HI*,4X,2HT*,5X,2HP*,6X,2HX*,5X,2HL*)
   50 FORMAT(27HMACRO-ECONOMIC MODEL 600.02//)
   55 FORMAT(1X,I5,4X,A4,A4,A4,A4,A4,I2,F4.1,F3.3,F4.1,F4.3,F5.1,F4.1,
     19X,I4,A4,A4,A2)
   60 FORMAT(1HO,2X,I5,4X,A4,A4,A4,A4,A4,5X,11HCLASS CODE ,I4,10X,24H* I
     1NDICATES INPUT VALUES)
   70 FORMAT(1X,I5,2F8.1,2F7.1,F7.3,F8.1,F7.1,F8.1,F7.3,F7.1,F6.1,F6.3,
     1F7.3,F8.1,F7.1)
   72 FORMAT(1HO,I5,2F8.1,2F7.1,F7.3,F8.1,F7.1,F8.1,F7.3,F7.1,F6.1,F6.3,
     1F7.3,F8.1,F7.1)
   75 FORMAT(10HEND OF JOB//)
   80 FORMAT(1H3,2X,22HMACROECONOMIC MODEL-  ,A4,A4,A2,2X,7HCOLLEGE)
      END
```

MACROECONOMIC MODEL - RIVERSIDE COLLEGE

L7228 BESSON DONALD D CLASS CODE 241

YEAR	Y	C	I	G*	P	X	L	Q	U	T	I*	T*	P*	X*	L*
11	1229.1	738.4	195.6	295.0	1.281	958.7	96.7	1222.6	.037	280.3	-1.0	.305	1.264	938.4	95.0
12	1265.4	751.0	211.4	303.0	1.293	978.1	98.4	1268.8	.041	297.8	9.0	.310	1.281	958.7	96.7
13	1269.8	749.6	204.1	316.0	1.305	972.3	1001	1304.1	.053	302.9	1.0	.313	1.293	978.1	98.4
14	1305.8	766.4	199.4	340.0	1.318	990.4	101.9	1305.3	.039	315.5	3.5	.314	1.305	972.3	100.1
15	1383.2	802.4	224.8	356.0	1.358	1018.4	103.7	1346.8	.035	342.6	3.5	.316	1.318	990.4	101.9

* INDICATES INPUT VALUES

SAMPLE STUDENT OUTPUT

Note: test data generated by source program may deviate from these values due to minor program change.

A P P E N D I X B

Macroeconomic Model--Mark III

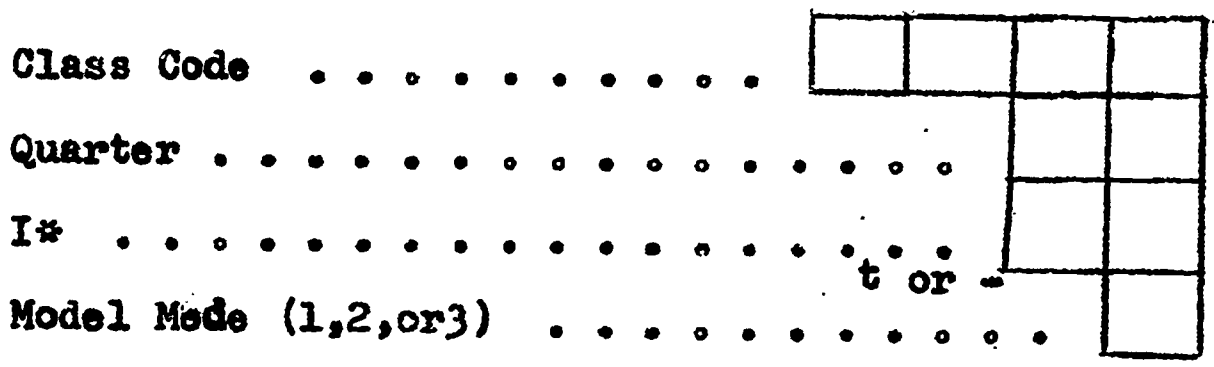
Contents:

1. Instructor Cover Form
2. Student Decision Form
3. The Model Defined
4. FORTRAN II Source Program
5. Sample Output
6. End-of-Game Source Program

MACROECONOMIC MODEL--Mark III

Riverside City College

Instructor Cover Form



Note: Mode 1

G* and T* decision variables allowed. M* = M_{t-1}

Mode 2

M* decision variable allowed. G* and T* = G_{t-1} and T_{t-1}

Mode 3

G*, T*, and M* decision entries allowed.

If no student entry, all decision variables are derived from previous history period.

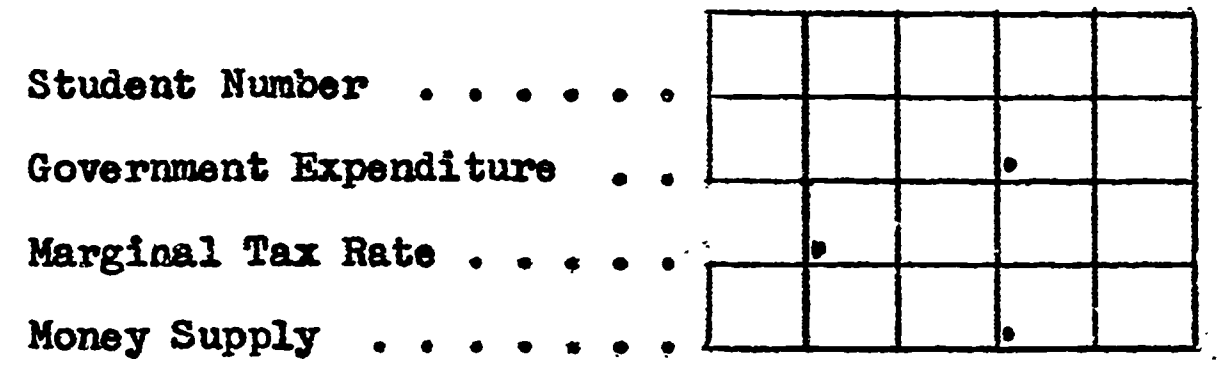
MACROECONOMIC MODEL--Mark III

Riverside City College

Student Decision Form

The student decision form may be constructed by using optical scanning answer sheets (as in APPENDIX A), or by using mark-sense cards.

Supplied by Student:



Failure to render a Decision Form on the date due will result in the use of the previous period's decision variables.

MACROECONOMIC MODEL--Mark III

Riverside City College

This quarterly model is based upon the work of Dolbear, Attiyeh, and Brainard. Their model has been modified in certain respects, reduced to computational formulas, and computer programmed for classroom use. The variables and parameters are amenable to revision and modification.

Supplied by Instructor: Class Code, QTR, I*, and Model Mode.

Supplied by Students: Student Number, G*, T*, and M*.

Supplied via History: QTR_{t-1}, A_{t-1}, L_{t-1}, K_{t-1}, I_{t-1}, $ADDON_{t-1}$, G^*_{t-1}, T^*_{t-1}, M^*_{t-1}, P_{t-1}, NNP_{t-1}, U_{t-1}.

Definitions

QTR = Quarter
GNP = Gross National Product
NNP = Net National Product
C = Consumption Expenditures
I = Net Investment
G = Government Expenditures
T = Government Tax Receipts
T* = Marginal Tax Rate
DI = Disposable Income
PS = Personal Savings
RE (BSAV) = Business Savings (retained earnings plus capital consumption allowances)
M = Money Supply
R = Rate of Interest
X = Deflated GNP
U = Unemployment Rate (percent)
P = Price Level Index
PCHG = Change in prices (percent) at annual rates
GROW = Quarterly change in NNP (expressed in decimal form)

Formulas Calculated:

I. Potential Output

1. $A_t = (1+.003)A_{t-1}$, $A_o = 2.7$
2. $L_t = (1+.002)L_{t-1}$, $L_o = 67$
3. $K_t = K_{t-1} + I_{t-1}$, $K_o = 2000$, $I_o = 100$

4. $Q_t = A_t L_t^{.67} K_t^{.33}$

II. Aggregate Demand

5. $D_t = 1 + (2.784)T^*_t$
6. $E_t = 1.25M_t/.3305\ P_{t-1}$
7. $NNP_t = 122.69/D + E/D + ADDON_{t-1}\ /(.3305D) + G^*_t/(.3305D) + I^*_t/(.3305D)$

   (Hereafter, NNP is Y.)
   Examine Y_t and Q_t. If $Y_t \leq Q_t$, $ADDON_t = 0$, go to equation 8. If $Y_t > Q_t$, $ADDON_t = (Y_t - Q_t)/ 3.2787$ and go to equation 18.
8. $C_t = 20 + .92(Y_t + 40 - T^*_t Y_t - .15Y_t)$
9. $I_t = -16.25 + 1.250\ M_t/P_{t-1} - .1125\ Y_t + ADDON_{t-1} + I^*_t$
10. $G_t = G^*_t$
11. $DI_t = Y_t - T_t - RE_t$
12. $T_t = -40 + T^*_t Y_t$
13. $RE_t = .15Y_t$
14. $M_t = M^*_t$
15. $R_t = (2250 - 50M_t/P_{t-1} + 12.5Y_t)/Q_t$, if $R < 3.00$ redefine $R = 3.00$
16. $GNP_t = 1.1\ Y_t$
17. $PS_t = DI_t - C_t$
18. (If $Y_t > Q_t$) $C_t = 20 + .92(Q_t + 40 - T^*_t Q_t - .15Q_t)$
19. $RE_t = .15Q_t$
20. $T_t = -40 + T^*_t Q_t$
21. $BI_t = Q_t - C_t - G_t$
22. $DI_t = Q_t + 40 - T^*_t Q_t - .15Q_t$
23. $Y_t = C_t + BI_t + G^*_t$
24. $GNP_t = 1.1\ Y_t$
25. $R_t = R_t$ in 15.

III Phillips Curve

26. $U_t = 100(.025 + .33\ (1-Y_t/Q_t)\ )$
27. if $Y_t/Q_t < .89$,
    $PCHG_t = 100(-1 + .9984 + .1(Y_t/Q_t - .89)\ )$
28. if $Y_t/Q_t \geq .89$
    $PCHG_t = 120(-1 + 4.06 - 7Y_t/Q_t + 4(Y_t/Q_t)^2)$
29. $P_t = 1.004\ P_{t-1}\ (1 + .0025PCHG_t)$

IV Economic Growth

30. $GROW = Y_t - Y_{t-1} / Y_{t-1}$, or if $Y > Q$,

$GROW = Q_t - Y_{t-1} / Y_{t-1}$

31. $X = GNP/P$

End of Game Program

A listing of students with their cumulative price level, average unemployment rate, and a weighted moving average of deflated GNP is prepared by the computer along with percentile rankings in each category and a comprehensive percentile ranking based upon the other three percentile rankings. This listing allows each student to compare the performance of his economy with that of others.

The listing is also convenient for grading purposes.

THE END

```
C     MACROECONOMIC MODEL III                                                  10
C     PROGRAM GENERATES 1ST HISTORY CARDS USING I=0, A=2.7, L=67.,             20
C     K=200., AI=100., Q=550., P=1., ADDON=0., T*=.300, M=125.,G=97.           30
C     INPUT DATA                                                               40
C     ----------                                                               50
C     1ST DATA CARD HAS CLASS CODE ALL OTHER CARDS HAVE STUDENT NAME           60
C     AND STUDENT NUMBER IN THE FOLLOWING FORMAT                               70
C     COVER CARD (CLASS CODE ONLY) CLASS CODE= CC1-6                           80
C     2 STUDENT CARD = CC1-20= STUDENT NAME, CC21-26=STUDENT ID NUMBER         90
C                                                                             100
    1 FORMAT(I6)                                                              110
    2 FORMAT(5A4,I6)                                                          120
    3 FORMAT(5A4,I3,5F10.2,/,5F10.2,2I6,F10.3,F7.2)                           130
    4 FORMAT(24H MACROECONOMIC MODEL III)                                     140
    5 FORMAT( 1H ,I5,1X,5A4,1X,11HCLASS CODE ,I4)                             150
    6 FORMAT(4H QTR,6X,3HGNP,6X,3HNNP,8X,1HC,8X,1HI,8X,1HG,8X,1HT,7X,         160
     *2HT*,7X,                                                                170
     12HDI,7X,2HPS,7X,2HRE,8X,1HM,8X,1HR,8X,1HX)                              180
    7 FORMAT(1H0,I4,12F9.2,F7.2)                                              190
    8 FORMAT(1H0,8X,1HU,8X,1HP,4X,4HPCHG,4X,4HGROW)                           200
    9 FORMAT(1H0,4F9.2)                                                       210
   80 FORMAT(1H1)                                                             220
      DIMENSION A1(5)                                                         230
      T1=.300                                                                 240
      PRINT 80                                                                250
      READ 1,ICODE                                                            260
      INITIAL START PROGRAM                                                   270
      BI=0.                                                                   280
      A=2.7                                                                   290
      AL=67.                                                                  300
      AK=2000.                                                                310
      AI=100.                                                                 320
      Q=550.                                                                  330
      P=1.000                                                                 340
      ADDON=0.                                                                350
      T=.300                                                                  360
      A=2.7                                                                   370
      AM=125.0                                                                380
      G=97.                                                                   390
                                                                              400
      POTENTIAL OUTPUT                                                        410
                                                                              420
      E=1.25*AM/.3305*P                                                       430
      D=T*2.784+1.                                                            440
      Y=122.69/D+E/D+ADDON/(.3305*D)+G/(.3305*D)+BI/(.3305*D)                 450
      A=A*(1.+.003)                                                           460
      AL=AL*(1.+.002)                                                         470
      AK=AK+BI                                                                480
      Q=A*AL**.67*AK**.33                                                     490
                                                                              500
      AGGREGATED DEMAND                                                       510
      RE= .15*Y                                                               520
      C=20.+.92*(Y+40.-T*Y-.15*Y)                                             530
      BI=-16.25+1.250*AM/P-.1125*Y+ADDON                                      540
      DI=Y+40.-T*Y-.15*Y                                                      550
```

```
      T=-40.+T*Y                                                          560
      R=((2250.-50.*AM/P+12.5*Y)/Q)                                       570
      GNP=C+BI+.03*AK+G                                                   580
      PS=DI-C                                                             590
      X=GNP/P                                                             600
      U=100.*(.025+.33*(1.-Y/Q))                                         610
      PCHG=100.*(-1.+.9984+.1*(Y/Q-.89))                                  620
   20 P=(1.+1./400.*PCHG)*P                                               630
   22 GROW=(Y-440.)/Y                                                     640
C                                                                         650
C     I/O  ROUTINE                                                        660
      IQT=1                                                               670
   10 READ 2,A1,ID                                                        680
      PUNCH 3,A1,IQT,A,AL,AK,BI,ADDON,G,T,AM,P,Y,ICODE,ID,T1,U            690
      PRINT 4                                                             700
      PRINT 5,ID,A1,ICODE                                                 710
      PRINT 6                                                             720
      PRINT 7,IQT,GNP,Y,C,BI,G,T,T1,DI,PS,RE,AM,R,X                       730
      PRINT 8                                                             740
      PRINT 9,U,P,PCHG,GROW                                               750
      GO TO 10                                                            760
      END                                                                 770
C                                                                          10
```

```
MACROECONOMIC MODEL III PRODUCTION PROGRAM                              20
                                                                       30
                                                                       40
                                                                       50
PROGRAM OPREATIONS AND CARD FORMATS                                    60
-----------------------------------                                    70
1. THE PROGRAM MUST HAVE A *FANDK0806 CONTROL CARD                     80
                                                                       90
2. ONLY 70 STUDENTS CAN PLAY THE GAME IN ONE PASS OF THE PROGRAM       100
                                                                       110
3. IF LESS THAN 70 STUDENTS PLAY THE GAME A BLANK CARD MUST BE         120
PLACED BEHIND THE STUDENT DECISION CARDS                               130
                                                                       140
4. STUDENT DECISION CARDS ARE PLACED AHEAD OF THE STUDENT HISTORY      150
   CARDS                                                               160
                                                                       170
INPUT FORMATS                                                          180
-------------                                                          190
                                                                       200
1. STUDENT DECISION CARDS                                              210
CC 1-6 STUDENT ID NUMBER                                               220
CC 7-14 THE VALUE FOR G                                                230
CC 15-22 THE VALUE FOR T                                               240
CC 23-30 THE VALUE FOR M                                               250
                                                                       260
2. INSTRUCTOR COVER CARD                                               270
NOTE THIS IS THE FIRST DATA CARD TO BE READ                            280
CC 1-6 CLASS CODE                                                      290
CC 7-10 THE GAME QTR.                                                  300
CC11-14 THE PROGRAM MODE                                               310
CC 15-18 IS THE I BAR VALUE IN FIXED POINT                             320
    DIMENSION G1(70),T1(70),AM1(70),ID1(70),A1(5)                      330
  1 FORMAT(I6,3I4)                                                     340
  2 FORMAT(I6,3F8.2)                                                   350
  3 FORMAT(5A4,I3,5F10.2,/,5F10.2,2I6)                                 360
  4 FORMAT(21HONO DECISION CARD FOR,1X,5A4)                            370
 11 FORMAT(5A4,I3,5F10.2,/,3F10.2,2F10.3,2I6,F10.3,F7.2)               380
 12 FORMAT(24HOMACRODECONOMIC MODEL III)                               390
 13 FORMAT(1H ,I6,1X,5A4,1X,11HCLASS CODE ,I6)                         400
 14 FORMAT(4H QTR,6X,3HGNP,6X,3HNNP,8X,1HC,8X,1HI,8X,1HG,8X,1HT,7X,    410
   *2HT*,7X,                                                           420
   12HDI,7X,2HPS,7X,2HRE,8X,1HM,8X,1HR,8X,1HX)                         430
 15 FORMAT(1H0,I4,12F9.2,F7.2)                                         440
 16 FORMAT(1H0,8X,1HU,8X,1HP,4X,4HPCHG,4X,4HGROW)                      450
 17 FORMAT(1H0,4F9.2)                                                  460
 80 READ 1,ICD,IQTR,MODE,IB                                            470
C                                                                      480
C    READ INSTRUCTOR COVER FORM CLASS CODE, GAME MODE AND I BAR        490
C                                                                      500
    ICC=0                                                              510
    DO 221 I=1,70                                                      520
    ID1(I)=0                                                           530
    G1(I)=0.                                                           540
    T1(I)=0.                                                           550
221 AM1(I)=0.                                                          560
    DO 50 I=1,70                                                       570
```

```
   READ 2,ID1(I),G1(I),T1(I),AM1(I)                                    580
   IF(ID1(I))50,51,50                                                  590
                                                                       600
   READ STUDENT DECISION CARDS                                         610
   LAST DECISION CARD IS BLANK                                         620
   69 STUDENTS TOTAL CAN PLAY THE GAME                                 630
                                                                       640
50 CONTINUE                                                            650
                                                                       660
   DECISION CARD INPUT                                                 670
                                                                       680
51 READ11,A1,KQTR,A,AL,AK,BI,ADDON,G,T,AM,P,Y,ICD,ID,T2                690
   ADDON1=ADDON                                                        700
   Y1=Y                                                                710
                                                                       720
   READ HISTORY CARD                                                   730
                                                                       740
   AI=I3                                                               750
   DO 52 I=1,70                                                        760
   IF(ID-ID1(I))52,53,52                                               770
                                                                       780
   IF ID=ID1 DECISION CARD MATCHES THE HISTORY CARD AND THE PROPER      790
   INDEXES ARE SET. IF NO MATCH IS FOUND FOR THE HISTORY CARD AN       800
   ERROR IS PRINTED AND THE HISTORY VALUES ARE COMPUTED                810
                                                                       820
53 GX=G1(I)                                                            830
   TX=T1(I)                                                            840
   AX=AM1(I)                                                           850
   GO TO 54                                                            860
52 CONTINUE                                                            870
   PRINT 4,A1                                                          880
   GX=G                                                                890
   TX=T2                                                               900
   AX=AM                                                               910
   GO TO 57                                                            920
                                                                       930
   IF NO DECISION CARD IS SUPPLIED SET PROPER VALUES FOR GX,TX AND     940
   AX --- PRINT A WARNING MESSAGE                                      950
                                                                       960
54 GO TO(55,56,57),MODE                                                970
                                                                       980
   SET THE PROPER VALUES DEPENDING ON THE PROGRAM MODE                 990
                                                                      1000
55 AX=AM                                                              1010
   GO TO 57                                                           1020
56 GX=G                                                               1030
   TX=T2                                                              1040
                                                                      1050
   POTENTIAL OUTPUT                                                   1060
                                                                      1070
57 E=1.25*AX/.3305*P                                                  1080
   D=TX*2.754+1.                                                      1090
   Y=122.69/D+E/D+ADDON/(.3305*D)+GX/(.3305*D)+AI/(.3305*D)            1100
   A=A*(1.+.003)                                                      1110
   AL=AL*(1.+.002)                                                    1120
   AK=AK+BI                                                           1130
```

```
      Q=A*AL**.67*AK**.33                                                  1140
      IF(Y-Q)58,59,59                                                      1150
   59 ADDON=0                                                              1160
   58 IF(Y-Q)61,61,60                                                      1170
C                                                                          1180
C     IF Q IS GREATER THAN Y COMPUTE VALUES USING Q                        1190
C                                                                          1200
   60 ADDON=(Y-Q)/3.2787                                                   1210
      C=20.+.92*(Q+40.-TX*Q-.15*Q)                                         1220
      RE=.15*Q                                                             1230
      T=-40.+TX*Q                                                          1240
      U=100.*(.025+.33*(1.-Q/Q))                                           1250
      BI=Q-C-G                                                             1260
      DI=Q+40.-TX*Q-.15*Q                                                  1270
      Y=C+BI+GX                                                            1280
      GNP=1.1*Y                                                            1290
      GO TO 62                                                             1300
   61 RE=.15*Y                                                             1310
      C=20.+.92*(Y+40.-TX*Y-.15*Y)                                         1320
      BI=-16.25+1.250*AX/P-.1125*Y+ADDON1+AI                               1330
      T=-40.+TX*Y                                                          1340
      U=100.*(.025+.33*(1.-Y/Q))                                           1350
      GNP=1.1*Y                                                            1360
      DI=Y+40.-TX*Y-.15*Y                                                  1370
   62 R=((2250.-50.*AX/P+12.5*Y)/Q)                                        1380
      IF(R-3.)300,400,400                                                  1390
  300 R=3.                                                                 1400
  400 PS=DI-C                                                              1410
      X=GNP/P                                                              1420
      PCHG=100.*(-1.+.9984+.1*(Y/Q-.89))                                   1430
      IF((Y/Q)-.89)70,70,71                                                1440
   71 PCHG=120.*(-1.+4.06-7.*Y/Q+4.*(Y/Q)**2)                              1450
   70 P=1.004*(P)+P*(PCHG)/400.                                            1460
      IF(Y-Q)500,500,501                                                   1470
C                                                                          1480
C     COMPUTE THE VALUE OF GROW DEPENDING  ON THE VALUE OF Q               1490
C                                                                          1500
  500 GROW=(Y-Y1)/Y1                                                       1510
      GO TO 502                                                            1520
  501 GROW=(Q-Y1)/Y1                                                       1530
C                                                                          1540
C     I/O ROUTINE                                                          1550
C                                                                          1560
  502 PUNCH 11,A1,IQTR,A,AL,AK,BI,ADDON,GX,T,AX,P,Y,ICD,ID,TX,U            1570
  150 PRINT 20                                                             1580
   20 FORMAT(1H0)                                                          1590
      ICC=ICC+1                                                            1600
      IF(ICC-4)100,100,101                                                 1610
  100 PRINT 12                                                             1620
      PRINT 13,ID,A1,ICD                                                   1630
      PRINT 14                                                             1640
      PRINT 15,IQTR,GNP,Y,C,BI,GX,T,TX,DI,PS,RE,AX,R,X                     1650
      PRINT 16                                                             1660
      PRINT 17,U,P,PCHG,GROW                                               1670
      IF(IQTR)51,80,51                                                     1680
```

```
101 PRINT 102                                                    1690
102 FORMAT(1H3)                                                  1700
    ICC=0                                                        1710
    GO TO 150                                                    1720
    END                                                          1730
```

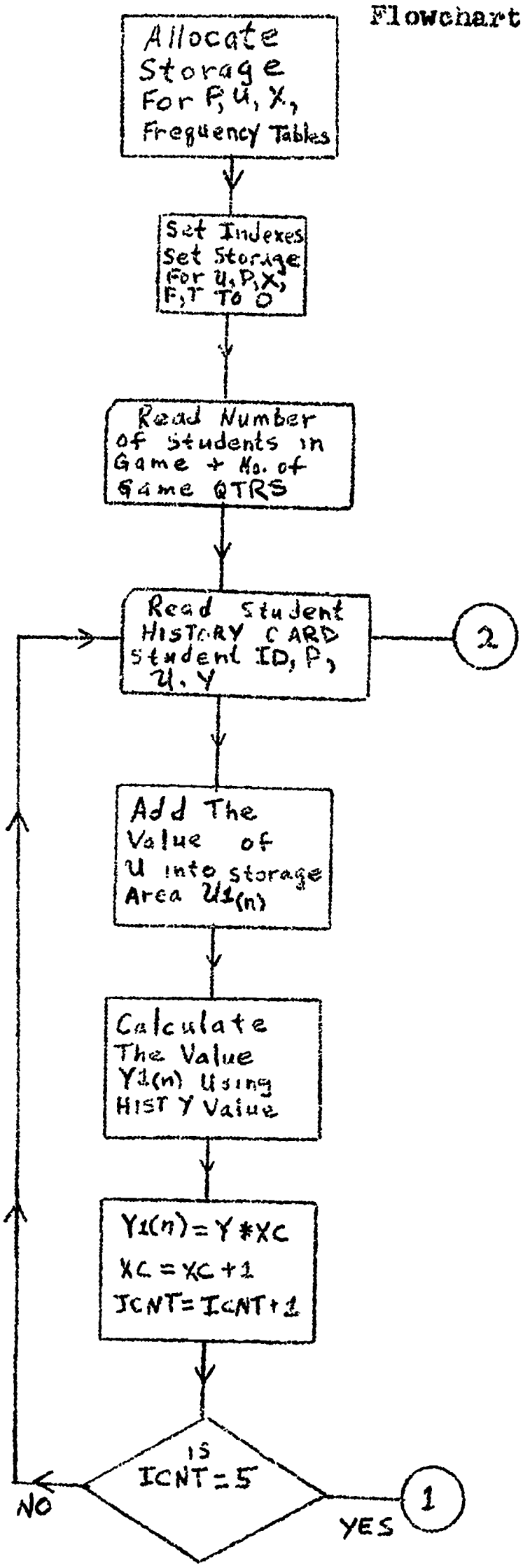
Sample Output

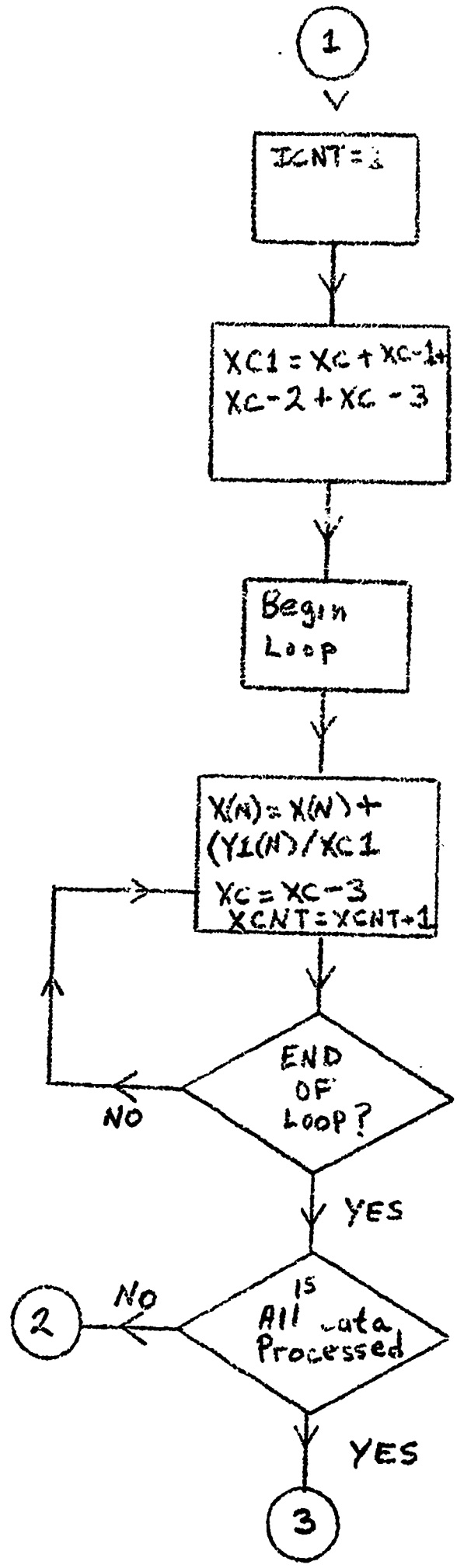
MACROECONOMIC MODEL III

2102 FRED THOMPSON CLASS CODE 1234

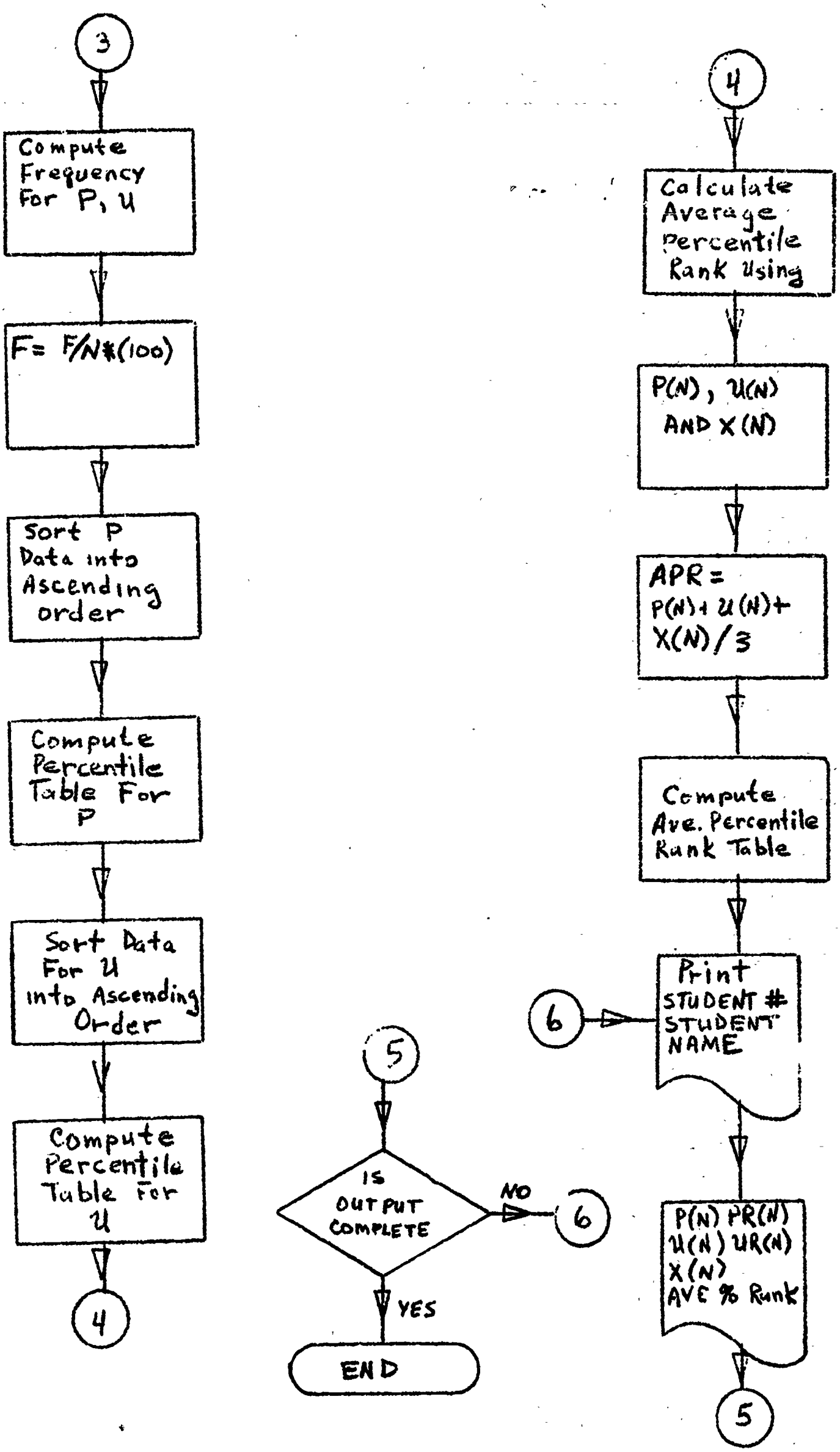
QTR	GNP	NNP	C	I	G	T	T*	DI	PS	BSAV	M	R	X	U	P	PCHG	GROW
1	544.4	484.3	301.9	85.5	97.0	105.3	.30	306.4	4.5	72.6	125.0	3.68	544.4	6.81	.99	-.36	.09
2	543.6	494.2	311.4	88.4	97.5	103.3	.29	316.7	5.3	74.1	126.2	3.63	549.1	6.67	.99	-.32	.02
3	556.7	506.1	322.2	85.6	100.5	101.7	.28	328.5	6.2	75.9	127.0	3.79	560.6	6.41	.99	-.24	.02
4	580.5	527.7	338.4	85.6	105.0	102.4	.27	346.0	7.6	79.1	128.5	4.11	582.8	5.59	1.00	.16	.04
5	602.2	547.4	351.4	87.5	108.5	105.0	.26	360.2	8.8	82.1	131.5	4.26	602.2	4.89	1.00	1.01	.03
6	621.0	564.6	363.2	89.3	110.0	106.8	.26	373.1	9.8	84.6	134.5	4.38	617.3	4.35	1.01	1.96	.03
7	640.1	581.9	375.3	90.4	111.4	108.3	.25	386.2	10.8	87.2	138.0	4.48	631.2	3.82	1.02	3.15	.03

Year-End Program
Flowcharting Worksheet *





*This General Flow Diagram is substituted for the FORTRAN II program which was developmental at the time of this report.


3
Compute Frequency For P, U
F= F/N*(100)
Sort P Data into Ascending order
Compute Percentile Table For P
Sort Data For U into Ascending Order
Compute Percentile Table For U
4
4
Calculate Average Percentile Rank Using
P(N), U(N) AND X(N)
APR = P(N)+U(N)+ X(N)/3
Compute Ave. Percentile Rank Table
Print STUDENT # STUDENT NAME
6
P(N) PR(N) U(N) UR(N) X(N) AVE % Rank
5
5
IS OUTPUT COMPLETE
NO
6
YES
END

A P P E N D I X C

Microeconomic Model

Contents:

1. Instructor Cover Form
2. Player Decision Form
3. Operating Statement
4. Income Statement
5. Year-End Industry Summary

RIVERSIDE CITY COLLEGE

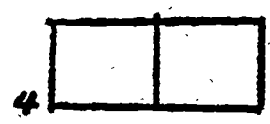
THE EXECUTIVE GAME

Instructor Cover Form

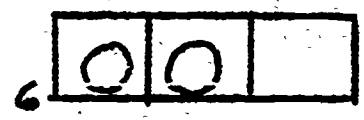
Identification: Industry No.

No. of Firms (2-9)

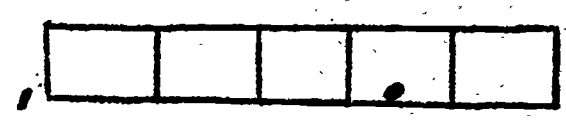
Period (1-12)



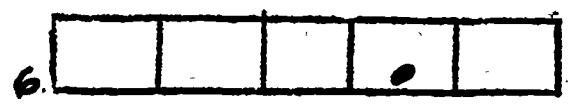
Quarter (1-4)



Economic Indices: Economic Index



Seasonal Index



Instructor Name: _____

Submitted: Date _____ by _____ time _____

Received: Date _____ by _____ time _____

Completed: Date _____ by _____ time _____

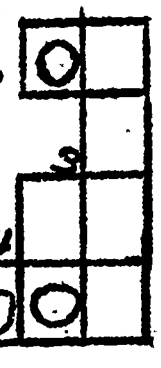
RIVERSIDE CITY COLLEGE

THE EXECUTIVE GAME

Player Decision Form

Identification Data:

1. Industry No. . . . . ,
2. Firm No. (2-9) 3
3. Period No. (1-12). 4
4. Calender Quarter (1-4) 6

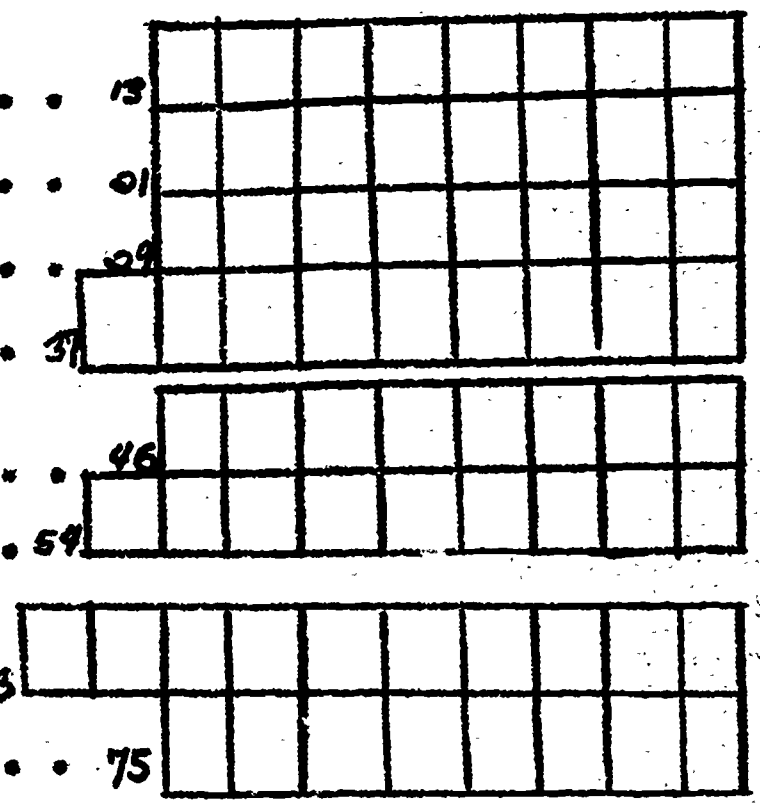


Decision Data:

5. Price ($9.99 limit) 9

Note: Item 6-13 values entered as whole dollars.

6. Marketing & Advertising Budget 13
7. Research & Development 01
8. Maintenance 29
9. Scheduled Production 37
10. Plant Investment (depreciation and new capacity) 46
11. Raw Materials Pruchase 1 54
12. Miscellaneous (no entry unless penalty charged) 63
13. Dividends 75



EXECUTIVE GAME MODEL 1

PERIOD 11 CAL QTR 3 ECONOMIC INDEX 113.

INFORMATION ON COMPETITORS

		PRICE	DIVIDEND	SALES VOLUME	N PROFIT
FIRM	1	$ 6 65	$ 232380.	530863.	$ 205417.
firm	2	$ 6.70	$ 659990.	466173.	$ 220519.
firm	3	$ 6.65	$ 500000.	666014.	$ 373803.
FIRM	4	$ 6.90	$ 0.	380000.	$ 46876.
FIRM	5	$ 6.50	$ 200000	625000	$ 247663.
FIRM	6	$ 6.65	$ 0.	543923.	$ 169231.

FIRM 20 1 PERIOD 11 CAL QTR 3

OPERATING STATEMENTS

MARKET POTENTIAL	553517.
SALES VOLUME	530863.
PERCENT SHARE OF INDUSTRY SALES	16.
PRODUCTION THIS QUARTER	527132.
INVENTORY FINISHED GOODS	0.
PLANT CAPACITY NEXT QUARTER	375323.

PERIOD 11 CAL QTR 3 FIRM 20 1

INCOME STATEMENT

RECEIPTS, SLAES REVENUE			$ 3530243.
EXPENSE			
LABOR (COST/UNIT EX OVERTIME 1.43)		$ 859725.	
MATERIALS (COST/UNIT 1.61)		852069.	
REDUCTION FINISHED GOODS INV.		11193.	
ADMINISTRATION		323183.	
MARKETING		550000.	
RESEARCH AND DEVELOPMENT		75000.	
MAINTENANCE		99671.	
DEPRECIATION		192473.	
MISCELLANEOUS		171893.	3135210.
RAW MAT. CARR. COSTS	42603.		
FIN. GOODS CARR. COSTS	0.		
PLANT INV. EXPENSES	0.		
FINANCING CHARGES	0.		
ORDERING COSTS	50000.		
SUNDRIES	79290.		
PROFIT BEFORE INCOME TAX			$ 395033.
ADDITION TO INCOME TAX FUND			189616.
NET PROFIT AFTER INCOME TAX			205417.
DIVIDENDS PAID			232380.
ADDITION TO OWNERS EQUITY			-26963.

CASH FLOW

RECEIPTS, SALES REVENUE			3530243.
DISBURSEMENTS			
CASH EXPENSE		$ 2079473.	
ADDITION TO INCOME TAX FUND		189616.	
DIVIDENDS PAID		232380.	
INVESTMENT IN PLANT		0.	
PURCHASE OF MATERIALS		950000.	3451469.
ADDITION TO CASH ASSETS			78774.

BALANCE SHEET

ASSETS	
NET CASH ASSETS	1748951.
INV. VALUE, FINISHED GOODS	0
INVENTORY VALUE, MATERIALS	950000.
PLANT NET BOOK VALUE	7506466.
OWNERS EQUITY	10205417.

EXECUTIVE GAME
END OF FISCAL YEAR 3.

FIRM NO.		NET CASH ASSETS ($)	INV VAL. FIN GOODS ($)	INV VAL MATERIALS ($)	PLANT VAL ($)	OWNERS EQUITY ($)
20	1	283'260.	0.	18794.	7318798.	10168852.
20	2	1270068.	60992.	0.	8920216	10251276.
20	3	1935391.	45218.	0.	8994433.	10975042.
20	4	1327581.	0.	0.	9734455.	11062036.
20	5	1478553.	0	0.	9713242.	11191795.
20	6	1538761.	37354.	228367.	10244101.	12048583.

AVERAGES PER QUARTER FOR FISCAL YEAR 3. Only

FIRM NO.		MKT ($)	R D ($)	SALES VOL (UNITS)	NET PRF ($)	RATE OF RETURN* (PERCENT)	RANK*
20	1	687500.	81250.	582966.	183697.	1.436	2
20	2	400000.	87500	452893.	205793.	1.351	3
20	3	500000.	246250.	642542.	363271.	1.875	1
20	4	475000	143750.	464626.	116815.	.979	6
20	5	462500	87500.	495865.	100016.	1.006	5
20	6	525000.	75000.	527836.	205940.	1.339	4

* RANK AND RATE OF RETURN ARE BASED UPON DIVIDEND PAYOUT FOR ALL 12 PERIODS AND OWNERS EQUITY AT THE END OF FISCAL YEAR 3.

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